

WHAT IS CLAIMED IS:

1. A semiconductor device including a capacitor, comprising:
 - a lower electrode of said capacitor which has an upper surface and a side
5 surface and has an opening on said upper surface;
 - an electric conductor or an insulator provided at least in the vicinity of an entry
in said opening and containing a material of said lower electrode as a part of a
composition;
 - a dielectric film of said capacitor which is provided to face said upper surface
10 and said side surface of said lower electrode; and
 - an upper electrode of said capacitor which is provided to face said lower
electrode through said dielectric film.
2. The semiconductor device according to claim 1, wherein said electric
15 conductor or said insulator is also provided on said upper surface of said lower electrode
successively from an inside of said opening.
3. The semiconductor device according to claim 2, wherein said electric
conductor or said insulator is also provided on said side surface of said lower electrode
20 successively from said upper surface of said lower electrode.
4. A semiconductor device including a capacitor, comprising:
 - a lower electrode of said capacitor which has an opening;
 - an insulator provided in a bottom portion of said opening without completely
25 filling in said opening;

a dielectric film of said capacitor which is provided on said insulator and said lower electrode without completely filling in said opening; and

an upper electrode of said capacitor which is provided on said dielectric film.

5 5. The semiconductor device according to claim 4, wherein said lower electrode has a roughened inner surface in said opening and/or has such a shape that said opening is gradually narrowed from an entry toward said bottom portion.

10 6. A semiconductor device including a plug, comprising:
an interlayer film having a hole;
a plug body provided in said hole with an opening in an entry of said hole; and
an electric conductor provided on an inside and outside of said hole to close
said opening of said plug body and provided so as not to come in contact with said
interlayer film, and containing a material of said plug body as a part of a composition,
15 said plug including said plug body and said electric conductor.

7. A method of manufacturing a semiconductor device, comprising the steps
of:
(a) forming an interlayer film and opening said interlayer film to form a hole;
20 (b) forming a conductive film on said interlayer film to provide said
conductive film in said hole;
(c) removing a portion of said conductive film which is provided on an
outside of said hole, thereby exposing said interlayer film; and
(d) oxidizing, siliciding or nitriding an exposed surface of said conductive
25 film, thereby forming an oxide film, a silicide film or a nitride film.

8. The method of manufacturing a semiconductor device according to claim 7, wherein said step (d) includes the step of forming said oxide film or said nitride film by plasma oxidation or plasma nitriding.

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9. The method of manufacturing a semiconductor device according to claim 7, wherein said semiconductor device comprises a capacitor including, as a lower electrode, a portion of said conductive film which is provided in said hole,

said manufacturing method further comprising the steps of:

10 (e) removing said interlayer film after said step (c) to expose a side surface of said lower electrode;

(f) forming a dielectric film of said capacitor to face an upper surface and said side surface of said lower electrode after said steps (d) and (e); and

15 (g) forming an upper electrode of said capacitor to face said lower electrode through said dielectric film.

10. The method of manufacturing a semiconductor device according to claim 9, wherein said step (e) is executed before said step (d).

20 11. The method of manufacturing a semiconductor device according to claim 9, wherein said step (e) includes the step of removing said interlayer film to leave a part of said interlayer film.

25 12. The method of manufacturing a semiconductor device according to claim 7, further comprising the step of:

(h) removing a portion of said oxide film, said silicide film or said nitride film which is provided on an outside of said hole.

13. A method of manufacturing a semiconductor device including a capacitor,
5 comprising the steps of:
- (i) forming an interlayer film and opening said interlayer film to form a hole;
 - (j) forming a conductive film along an exposed surface in said hole;
 - (k) forming an insulator on said conductive film to fill in said hole;
 - (l) removing a portion of said conductive film which is provided on an outside
10 of said hole to expose said interlayer film, thereby forming a lower electrode of said capacitor by said conductive film;
 - (m) removing said insulator to leave a part of said insulator in a bottom portion of an opening of said lower electrode corresponding to said hole;
 - (n) removing said interlayer film to expose said lower electrode;
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 - (o) forming a dielectric film of said capacitor on said insulator and said lower electrode without completely filling in said opening after said steps (m) and (n); and
 - (p) forming an upper electrode of said capacitor on said dielectric film.

- 20 14. The method of manufacturing a semiconductor device according to claim 13, wherein said step (n) includes the step of removing said interlayer film to leave a part of said interlayer film.